

ASSESSMENT OF THE CAUSES OF WATER SCARCITY IN MINNA METROPOLITAN AREA OF NIGER, STATE: A NEED FOR SUSTAINABLE DEVELOPMENT

¹IMAM ISA

Centre for Human Settlement & Urban Development, Federal University of Technology, Minna, Niger State.

Contact of the correspondent author: isa.imam82@hotmail.com/ +234 803 700 4492

²YUNUSA, MOHAMMED BADAMASI

Centre for Human Settlement & Urban Development, Federal University Technology, Minna, Niger State.

yakubu_imam@yahoo.com/+2348037420994

³OHIDA MUHAMMED ETUDAIYE

Department of Transport & Logistics Management, Confluence University of Science and Technology, Osara, Kogi State.

Ohidamuhammedetudaiye@gmail.com/+2347034480533

ABSTRACT

The reasons for water scarcity in any given environment are numerous, and the only way to regulate the excesses of water scarcity is to identify the underlining cause of water scarcity in the society. As a result, the purpose of this research is to investigate the causes of water scarcity in the Minna metropolitan region. Using Taro Yamane's (1967) formula, the study employs random sampling to distribute 400 questionnaires to the chosen respondents. From the eleven factors assessed using factor analysis, five primary causes of water scarcity were extracted. The collected data was analysed using descriptive statistics, and the inferential statistics were evaluated using the Chi-square test. The study results show that inadequate resources to provide adequate water supply (P-value = .000), inadequate pumping infrastructures (P-value = .000), increasing population (P-value = .000), inaccessibility of the area due to lack of road infrastructures (P-value = .000) and inadequate water distribution tanker (p-value = .000) were statistically significant at 0.05 confidence level. In conclusion, a sustainable water supply is essential to address Minna's water scarcity issues. The research recommends, among other that the Niger state government do all possible to provide appropriate funding for water abstraction infrastructure and other elements that support water distribution in Minna.

Keywords: Water scarcity, corruption, inadequate water distribution tanker, leaking pipes

JEL: Q25

1 INTRODUCTION

Water is a natural resource that is vital to human survival. Humans need water for a wide range of uses, including household, agricultural, construction, and industrial ones. Water shortage has been a problem in several regions of the world due to water pollution, climate change, and expanding urban populations (Olivia, 2022). The United Nations Children's Fund (UNICEF, 2021) states that there is a water shortage when there is a shortage of water resources and the demand for water exceeds the supply.

Physical water shortage and economic water scarcity are the two categories under which water scarcity is categorized (IPCC, 2022). According to Rijsberman (2006), physical water shortage occurs when there is not enough water available to meet all demands, including those placed

on ecosystems. Economic water scarcity is a result of inadequate human capacity to supply the demand for water or a lack of investment in infrastructure or technology to collect water from rivers, aquifers, or other water sources (IPCC, 2022).

More than 40% of the world's population already experiences water scarcity, a worrying statistic that is projected to grow as temperatures rise due to climate change (Bature, 2021). Water is one of the biggest threats to economic development, the eradication of poverty, and sustainable development in many places due to inadequate access to water supply and sanitation, growing populations, more water-intensive patterns of growth, increasing rainfall variability, and pollution (World Bank, 2022).

Long-term water stress or scarcity can have severe effects on the general public's health, the availability of food, and the spread of illness (Howell, 2020). Therefore, a sustainable source of water is needed to improve urban residents' health and way of life. For many years, there has been a problem with water scarcity in Nigerian cities, and Minna is one of those places. Water shortage problems are more prevalent during the dry seasons.

According to literature, the main causes of water scarcity in most communities are: insufficient water storage facilities, a lack of maintenance culture, corruption, leaking pipes, and poverty (Ishiaku et al., 2014; Obisesan & Famous, 2016; Ibrahim et al., 2014; Hassan & Abbas, 2015). Water shortages in Minna are also a result of insufficient water tanker vehicles that cannot give water to places that are not connected to water distribution pipes. Studies on the causes of water scarcity are still sparse, according to the literature, and there is room for improvement in the areas of inadequate facilities to meet water demand, inadequate water distribution tanker vehicles, corruption within water boards, and inadequate pumping infrastructure, which is where the aforementioned study aims to fill the gap. In light of this, the current study aims to identify the underlying causes of water scarcity in the Minna metropolis and propose a sustainable measure to eliminate the problem of water scarcity in Minna.

2 LITERATURE REVIEW

2.1 Theoretical Review

Any region's reasons of water scarcity can be best understood by a number of management ideas. The most common use of this theory is the Resource Base View (RBV). RBV theory was created by Barney (1991). The theory's underlying tenet is that firms are heterogeneous because they have different resource mixes, which enable firms to have a range of strategies. Following this logic, water distribution firms plan water deliveries to any home area while taking into consideration the available resources. Another theory that clarifies the possible causes of water scarcity is the concept of constraints (TOC). The TOC theory was developed by Eliyahu in 1984. A limitation, according to Eliyahu (1984), is anything that hinders the system from attaining its objective. A fundamental tenet of TOC is that there shouldn't be dozens or even hundreds of constraints. Limitations can take many different forms. A water distribution company's inability to effectively distribute water may be the root cause of water scarcity. This internal element could be employee corruption or a lack of pumping infrastructure, which results in water being diverted to areas where they have personal interests. Similar to this, the failure of a physical component is how water supply reliability is defined. The water supply reliability theory was initially introduced by Shamir and Charles (1981). According to the theory a single failure or for a specified time period, a dependability factor can be built using demand rate or demand volume. In this approach, a lack of water at the sources may affect the reliability of supply and, at some point, cause a water shortage in residential areas.

2.2 Simple cause & effect of water scarcity

The United Nations has recognized that water scarcity is a widespread issue in the world. Numerous reasons contribute to water scarcity. Apart from droughts, Olivia (2022) claims that water shortages are caused by climate change, poor water management, and excessive use worldwide. Similar to this, Kieran (2022) posited that climate change, water waste, war, and a lack of infrastructure are the main drivers of water scarcity. According to Obsessen and Famous (2016) research, the key reasons of water scarcity in Owah Abba include corruption, negative government policies, water supply facility theft, and vandalism. Access to water, water contamination, and unlawful dumping of garbage on water are further reasons of water scarcity.

Water scarcity, on the other hand, affects 1.1 billion people globally owing to a lack of access to water, and 2.7 billion experience water scarcity for at least one month of the year (World Wildlife Fund, 2023). According to the United Nations (UN, 2021), unfettered access to freshwater is a basic human right. And losing access to drinking water can be harmful to human health and life, as we all require water to survive. As a result, water scarcity and shortage can have major environmental consequences and jeopardize world peace and security.

2.3 Empirical review

Motsi and Daramy (2020) conducted a system analysis of portable water shortage in the Mpumalanga province of South Africa, with the goal of investigating water crises and pump effectiveness in Mpumalanga Province, as well as presenting a solution to the water shortages. The study results revealed that the main cause of water loss is due to a head bend in the pipe. In addition to the findings, the issue of water services in Mpumalanga can be solved and controlled through system analysis. The authors advised that the system be improved by increasing the length of the system to satisfy the demand for water supply.

Dangana and Muhammad (2016) conducted another study on household water accessibility in the southern part of Niger state. The study's goal was to look at the factors that influence household water accessibility in Niger State, Nigeria. The survey results show that a household's water accessibility is mostly influenced by distances, time spent obtaining water, low-income status to access contemporary water infrastructure, and, to a lesser extent, household size.

Ishiaku et al. (2014) investigated alternative residential water sources in Minna Metropolis, Niger State. According to the report, the main issue impeding water supply in Minna is insufficient monetary allocation to the Ministry of Water Resources. The authors concluded that increasing resource allocation to the Ministry of Water Resources in the form of a regulatory framework that guarantees private investment in the water sector, among other things, will improve water availability in Minna metropolitan.

Ibrahim et al. (2014) investigated residential water demand and supply adequacy in medium-sized towns in Niger State, Nigeria, as well as the obstacles to long-term growth. The study's goal was to analyse the sufficiency of residential water supply and its impact on demand in Niger state's medium-sized municipalities. The findings indicated a negative link between the value of water sources distribution and $\text{cal-t}=11.97$ and $\text{tab-t}=2.06$, which is relatively higher. Due to the distance between most families and water sources, the impossibility to purchase sufficient containers for saving water, and the lack of a maintenance culture, medium-sized communities have a severe shortage of domestic water supply. The study comes to the conclusion that water storage and treatment facilities should be built in every medium-sized town, with a workable policy of a maximum threshold of twenty-five homes per borehole or ten households to a well.

Mkonda (2015) conducted a study in Tanzania that looked at the effects of water scarcity on gender roles in semi-arid areas in the Mvumi Ward. According to the findings, the majority (about 70%) of rural towns are experiencing a serious water shortage situation. Instead of engaging in other economic pursuits, they spend more time fetching water. Additionally, women are more stressed out and exposed to this issue. In order to address this issue, the researcher suggested that rural areas need access to water services.

In Ghana's largest urban slum community, Monney et al. (2013) evaluated the community's accessibility to basic sanitation and potable water. The goals of the study were to assess the amount of stakeholder commitment to improving the existing circumstances as well as access to basic sanitation and potable water in Ghana's largest urban slum. According to the report, the community's daily water demands are totally met by vended water. The sources of drinking water are not only contaminated with associated health problems and marketed at high costs. Since there are no household toilets in the neighbourhood, people must only use the community's KVIP and pan latrines, which are both poor public restrooms.

Obisesan and Famous (2016) investigated Water Supply Factors in Owah-Abbi, Delta State. The study's purpose was to look at the elements that contribute to Owah-Abbi's insufficient water supply. According to the study findings, the causes of the water shortage in the Owah-Abbi community included corruption (37.33%), adverse government policies (25.33%), and theft and vandalism of Owah Abbi water delivery systems (17.33%). Others included the facilities' weak management culture (8.67%), the community's erratic power supply (6.67%), malfunctioning hydraulic equipment (2.67%), and negligence (2%).

Rahman et al. (2021) investigated the elements that might have an impact on the restoration of the water distribution network. With a focus on a series of one-on-one interviews with professionals in the sector who operate the WDN, the study's goal was to pinpoint factors that would have an impact on the rehabilitation of the Water Distribution Network (WDN). The study's conclusions showed that internal and external influences are two crucial factors affecting the rehabilitation of the water distribution network. Local governments and the area's neighbourhoods are external considerations, whereas cost, location, and design are internal.

Hassan and Abbas (2015) looked into the major causes of leakage in the urban water distribution network and water supply systems. The study's goal was to pinpoint the key factor causing leaks in the water supply system and urban water distribution system. The results showed that pressure, age, material, and pipe diameter might be taken into account at the expense of other criteria.

In a different study, Oyegoke et al. (2012) used the situation of Lagos state to examine the difficulties in providing water to a megacity. The purpose of the examination was to ascertain the element of water supply. The findings indicated that surface and groundwater sources, primary, secondary, and tertiary water treatment facilities, and pipe distribution networks are all important components of Lagos State's water supply. According to the study, there needs to be a fundamental shift in how water delivery projects are planned, carried out, maintained, and monitored.

3 METHODOLOGY

This research uses a descriptive research design. A descriptive survey is used to report on the characteristics of the population under study. It provides answers to queries such as the characteristics of the population analysed (Shields & Rangarjan., 2013). This study's population consists of the residents of Minna metropolis. According to the NPC (2006), Minna

had 293,000 residents in 2006 and is expected to have 469,320 by 2023 due to a growth rate of 2.81%. The sample size was calculated using the Taro Yamane (1967) formula in EQN (1).

$$n = \frac{N}{1+N(e)^2} \dots \dots \dots \text{eqn (1)}$$

Where n is the required sample size, N= population size, and e is the acceptable sample error. Base on the formula, a total of 400 questionnaires was administered to the residents of Minna with the aid of three field assistance for a period of seven days.

The questionnaires used for data collection are divided into two sections: the socioeconomic characteristics of the residents are covered in section one, while the causes of Minna's water scarcity are covered in section two. The second part of the questionnaires was created to record respondents' opinions using a 5-point Likert scale, where 5 represents strongly agreeing and 1 represents strongly disagreeing. The collated date was analysed using percentages, frequencies and component factor analysis was used to determine the major factors contributing to the causes of water scarcity in Minna metropolis. However, Chi-square was later used to test the study hypothesis.

4 RESULTS AND DISCUSSION

4.1 Socioeconomic features of the residents of Minna Metropolis

Table 1 Distribution of socioeconomic characteristics of the residents

Socioeconomic Variables	Frequency	%
Gender of the Resident		
Male	180	56.0
Female	140	44.0
N	320	100.0
Marital Status		
	Frequency	%
Married	170	53.1
Single	141	44.1
Divorce	9	2.8
N	320	100.0
Age of the residents		
	Frequency	%
< 18 years	20	6.3
19-29 years	85	25.6
30-40 years	94	29.4
41-50 years	83	25.9
>51 years	38	12.8
N	320	100.0
Educational background of the residents		
	Frequency	%
School Certificate	28	8.8
WAEC	41	12.8
Polytechnic certificate	73	22.8
Bachelor degree certificate	117	36.6
Others	67	39.0
N	320	100.0
Occupation of the residents		
	Frequency	%
Civil servant	87	27.2
Students	78	24.4

Farmers	59	18.4
Artisans	42	13.1
Business/Traders	54	16.9
N	320	100.0
Monthly income earned by the residents	Frequency	%
< N30,000	32	10.0
N31,000-60,000	55	17.2
N61,000-90,000	87	27.2
N91,000-120,000	53	16.6
>121,000	93	29.0
N	320	100.0

Sources: Authors' survey (2023)

Table 1 shows an investigation of the gender distribution of Minna metropolitan people. Based on the investigation, it was discovered that only 44% of Minna's citizens are female and that men make up around 56% of the city's population. The investigation in table 1 revealed the residents' marital status. According to the investigation, 53% of Minna's people were married, 44% were still single, and only 3% of the residents who took part in the study were divorced. Table 1 presents the study of the residents' ages. According to the results, 25.6% of the inhabitants were between the ages of 19 and 29 years, 29.4% of the people who participated in the survey were between the ages of 30 and 40 years, and 25.9% of the residents were between the ages of 41 and 50 years. Similarly, Table 1 shows that only 6.3% of people were under the age of 18, while 12.8% of residents were beyond the age of 51. Table 1 displays a study of the respondents' educational backgrounds. According to the analysis, 22.8% of Minna Metropolis citizens had polytechnic certificates, 39.0% had other certificates such master's and doctoral degrees, and 36.6% had bachelor's degrees. Similarly, Table 1 shows that just 8.8% of people had a primary school diploma whereas 12.8% of residents had a West Africa Examination Council (WAEC) certificate. Table 1 shows the analysis of the survey respondents' occupations who were Minna Metropolis inhabitants. According to the analysis, there were roughly 27.2% of civil servants, 24.4% of students, and 18.4% of farmers among the locals. Additionally, only 13.1% of the population were artisans and 16.9% of the citizens were business owners/traders. Additionally, according to Table 1, 29% of the people make more than ₦121,000 per month, 27.2% make between ₦61,000 and ₦90,000 per month, and 17.2% make between ₦31,000 and ₦60,000 per month. Finally, 16.6% of the residents claim to earn between ₦91,000 and ₦120,000 per month, with only 10.0% reporting incomes below ₦30,000.

4.2 Analysis of the causes of water scarcity in Minna Metropolis

Table 2 distribution of resident's response on Lack of facilities to accommodate the demand of water

Lack of facilities to accommodate Demand of water	Frequency	Percentages (%)
Strongly agree	49	15.3
Agree	56	17.5
Moderate	31	9.7
Disagree	117	36.6
Strongly disagree	67	20.9
Total	320	100.0

Sources: Authors' survey (2023)

Table 2, showed that 36.6% of Minna metropolis residents disagree that a lack of facilities to accommodate water demand results in water scarcity, 20.9% strongly disagree that a lack of facilities to accommodate demand for water does not result in water scarcity, and 17.5% agree. Furthermore, Table 2 reveals that just 9.7% of Minna metropolitan residents believe that a lack of facilities to handle water demand in Minna results in water scarcity, as opposed to 15.3% who strongly agree with this statement. Because the majority of Minna residents vehemently dispute that a lack of facilities to handle demand for water results in water scarcity, the author may draw the conclusion that this is not the case.

Table 3 distribution of residents’ response on Inadequate resources to provide adequate water supply

Inadequate resources to provide adequate water supply	Frequency	Percentages (%)
Strongly agree	55	17.2
Agree	174	54.4
Moderate	63	19.7
Disagree	28	8.7
Total	320	100.0

Sources: Authors survey (2023)

According to Table 3, approximately 54.4% of Minna metropolis residents agree that insufficient resources to provide adequate water supply are the causes of water scarcity in Minna, 19.7% said insufficient resources to provide adequate water supply cause water scarcity in Minna, 17.2% strongly agreed that insufficient resources to provide adequate water supply result in water scarcity, and only 8.7% disagree. Inadequate resources to provide adequate water supply has been a serious challenge in Minna, and in Nigeria at large. In order to provide portable water service, government at all level borrow to finance water sanitation project for instance, in May 2020, the Federal Government of Nigeria borrows about \$700 million from International Development Association (IDA) to provide six million Nigerians with portable water service (World bank, 2021). This outcome is in line with the work of Ishiaku et al. (2014) whom posited that Insufficient funding led to outdated equipment, insufficient pumps, insufficient cash for new waterworks, and insufficient electricity to power the existing water pumps.

Table 4: Respondents distribution on whether corruption among water board staff cause water scarcity in Minna Metropolis

Corruption among water board staff cause water scarcity	Frequency	Percentage (%)
Strongly agree	10	3.1
Agree	168	52.5
Moderate	39	12.2
Disagree	65	20.3
Strongly disagree	38	11.9
Total	320	100.0

Sources: Authors survey (2023)

Table 4 shows that 20.3% of Minna residents disagree that corruption among water board staff causes water scarcity in Minna Metropolis, 52.5% of residents agree that corruption among water board staff causes water scarcity in Minna Metropolis, and 12.2% of residents were moderate in their opinion. Similarly, only 3.1% of Minna residents strongly agree that

corruption among water board officials is a contributing factor to the city's water shortage, while 11.9% of locals strongly disagree with this statement. The main issue in Nigeria is corruption. Every individual can see that there is a lot of corruption in the country. Every sector of the economy has some level of corruption (Tobore, 202). Availability of corruption in water board authority might also hamper water supply, thereby causing water scarcity in Minna metropolis.

Table 5 Distribution of respondent response on whether inadequate Pumping infrastructure cause water scarcity in Minna

inadequate pumping infrastructure cause water scarcity	Frequency	Percentage (%)
Strongly agree	78	24.4
Agree	155	48.4
Moderate	36	11.3
Disagree	51	15.9
Total	320	100.0

Sources: Authors survey (2023)

According to Table 5, 48.4% of the population believes that Minna's water shortage is caused by insufficient pumping infrastructure, 24.4% strongly agree, 15.9% disagree, and only 11.3% are moderately sure. Water shortage is a result of many countries lacking the infrastructure necessary to effectively invest in their water resources and guarantee that clean water reaches those who need it most (Kieran, 2022).

Table 6: Distribution of respondents' response whether water shortage at sources cause water scarcity in Minna

Water shortage at the source cause water scarcity	Frequency	Percentage (%)
Strongly agree	80	25.0
Agree	223	69.7
Moderate	17	5.3
Total	320	100.0

Sources: Authors' survey (2023)

According to Table 6, 69.7% of Minna residents agree that water shortages at the sources are to blame for the city's water shortages, 25.0% strongly agree, and only 5.3% have a moderate opinion. The most common cause of piped water service disruption in most cities is a water scarcity at the source, if groundwater supply is insufficient (Desalegn, 2012).

Table 7: Distribution of the resident response on whether water loss due to leaks in distributional pipeline cause water shortage

Water loss due to leaks in distributional pipelines cause water scarcity	Frequency	Percentage (%)
Strongly agree	86	26.9
Agree	145	45.3
Moderate	59	18.4
Disagree	30	9.4
Total	320	100.0

Sources: Authors survey (2023)

Table 7 showed that 45.3% of Minna residents agree that water loss due to leaks in distributional pipelines causes water scarcity, 26.9% of them strongly agree that water loss due to leaks in distributional pipelines causes water scarcity, 18.4% of them were moderate in their opinion, and only 9.4% of Minna residents disagree that water loss due to leaks in distributional pipelines causes water scarcity. Many water distribution networks lose a substantial amount of water in transit from treatment plants to users. This water loss maybe attributed to leakages in the distributional pipelines. According to a 1991 International Water Supply Association (IWSA) investigation, the quantity of lost or unaccounted for water is normally in the range of 20-30% of production (Cheong 1991).

Table 8 Distribution of resident response on whether increasing population cause water scarcity

Whether Increasing population cause water scarcity	Frequency	Percentage (%)
Strongly agree	43	13.4
Agree	195	60.9
Moderate	9	2.8
Disagree	73	22.9
Total	320	100.0

Sources: Authors survey (2023)

Table 8, reveals that majority of Minna metropolis residents believe that the city's growing population is to blame for the city's water scarcity. Only 2.8% of residents held a moderate opinion, while 22.9% disagreed that Minna's growing population was to blame for the city's water scarcity, 13.4% strongly agreed, and 13.4% disagreed. However, a growing population will certainly result in increased food demand, a faster rate of urbanization, and an increase in industrial activities, all of which will necessitate an adequate supply of water (Lai, 2022). Therefore, it was concluded that an increasing population of Minna metropolitan area is one of the factors causing water scarcity in Minna.

Table 9 Distribution of resident response on whether poor access to distributional pipelines cause water scarcity

Poor access to distributional pipelines cause water scarcity	Frequency	Percentage (%)
Strongly agree	95	29.7
Agree	162	50.6
Moderate	56	17.5
Disagree	7	2.2
Total	320	100.0

Sources: Authors survey (2023)

Table 9 record that, 50.6% of Minna residents agree that poor access to distributional pipelines contribute to water scarcity, 29.7% strongly agree, 17.5% are moderately convinced, and only 2.2% disagree. This outcome enables the study to concluded that poor access to distributional pipeline cause water scarcity in Minna. This finding is consistent with the findings of Abdullahi and Abdulrahman (2015), who reported that 71% of the households in Jemeta, Yola, are not linked to water distribution pipelines, resulting in a water scarcity problem in the area.

Table 10 Distribution of resident response whether damages of water pipeline cause water scarcity

Damages of water pipeline cause water scarcity	Frequency	Percentage (%)
Strongly agree	61	19.1
Agree	215	67.2
Moderate	34	10.6
Disagree	10	3.1
Total	320	100.0

Sources: Authors survey (2023)

Table 10 indicate that 67.2% of Minna residents agree that water pipeline damage results in water scarcity in the city, 19.1% strongly agree, 10.6% are unsure, and 3.1% disagree. Damage of water pipelines are another cause of water scarcity in Minna metropolis. According Obisesan & Famous (2016) posited that poor citizen attitude towards government property may cause water scarcity problem. Government properties in Nigeria are no man properties and people don't care if it is damaged or being stole. Water for most households in Minna metropolis are lost due to damages to the distributional pipelines and most of these damages are cause by deliberate act by some individuals in the society.

Table 11 Distribution of respondent's response on inaccessible areas due to lack of road infrastructures

inaccessible areas due to lack of road infrastructures	Frequency	Percentage (%)
Strongly agree	101	31.6
Agree	179	55.9
Moderate	21	6.6
Disagree	19	5.9
Total	320	100.0

Sources: Authors survey (2023)

Table 11 showed that 55.9% of Minna metropolis residents agree that inaccessibility of the areas due to lack of road infrastructures, 31.6% strongly agree, 6.6% are undecided, and 5.9% disagree. This outcome enables the authors to conclude that inaccessibility of the areas due to lack of road infrastructure by government or private water tankers cause water scarcity in Minna. However, adequate road infrastructures are critical in the supply and distribution of water in areas not connected to pipelines.

Table 12 Distribution of respondent response on inadequate water distribution Tankers

inadequate water distribution Tankers	Frequency (%)	Percentage
Strongly agree	111	31.6
Agree	167	55.9
Moderate	24	6.6
Disagree	18	5.9
Total	320	100.0

Sources: Authors survey (2023)

The analysis in table 12 reveals that 55.9% of the respondents agree that inadequate water distribution tanker causes water scarcity in Minna, 31.6% of them strongly agree, 6.6% of the them were moderate in their view and only 5.9% of them disagree. This outcome enables the authors to believed that there is inadequate water distribution in Minna using water tanker. This

finding is in line with the work of Ishiaku et al. (2014) whom posited that none of the water consumers use tanker water as an alternative supply of water in Minna metropolis.

4.2 Test of hypothesis

The study hypothesis states that;

H₀₁ there is no statistically significant to the 5-key causes of water scarcity in Minna metropolis. In order to achieve the stated hypothesis, component factor was used to reduce the eleven (11) causes of water scarcity in Minna metropolis into 5-key causes. The outcome of the component factor analysis is shown in Table 13.

Table 13: Total explained variance

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Inadequate resources to provide adequate water supply	4.439	31.708	31.708	4.439	31.708	31.708
Inadequate Pumping Infrastructure	1.460	10.429	42.137	1.460	10.429	42.137
Increasing population	1.285	9.182	51.319	1.285	9.182	51.319
Inaccessible areas due to lack of road infrastructures	1.213	8.083	59.324	1.213	8.083	59.324
Inadequate water distribution Tankers	1.121	7.005	66.407	1.121	7.005	66.407
Lack of facilities to accommodate the demand of water	.769	5.495	77.984			
Corruption among water board staff	.716	5.115	83.099			
Water shortage at sources	.541	3.865	86.964			
Water loss due to leaks in distributional pipeline	.506	3.612	90.576			
Poor access to distributional pipelines	.282	2.017	98.371			
Damages of water Pipeline	.228	1.629	100.000			

Extraction Method: Principal Component Analysis.

Sources: Authors survey (2023)

Table 13 showed the total explained variables. From the analysis, it was noticed that there were total of 11 variables which were evaluated as the element causing water scarcity in Minna metropolis. However, the analysis reveals that Inadequate resources to provide adequate water supply (4.439), Inadequate pumping infrastructure (1.460), increasing population (1.285), inaccessibility of the areas due to lack of road infrastructures (1.213) and inadequate water distribution Tankers (1.121) has higher Eugene value more than 1. Therefore, these five major

elements were perceived by the resident of Minna as the most important factors causing water scarcity in Minna metropolis.

Table 14: Chi-square result

	Inadequate resources to provide adequate water supply	Inadequate Pumping Infrastructure	Increasing population	Inaccessibility areas due to lack of road	Inadequate water distribution Tanker
Chi-Square	152.031 ^a	104.781 ^a	192.344 ^a	63.625 ^c	48.372 ^c
Df	4	4	4	3	3
Asymp. Sig.	.000	.000	.000	.000	.000
Monte Carlo Sig.	.000 ^b	.000 ^b	.000 ^b	.000 ^b	.000 ^b
99% Confidence Interval					
Lower Bound	.000	.000	.000	.000	.000
Upper Bound	.000	.000	.000	.000	.000

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 64.0.

b. Based on 10000 sampled tables with starting seed 2000000.

c. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 80.0.

Sources; Authors survey (2023).

The Table 14 showed the Chi-square result. From the analysis it showed that inadequate resources to provide adequate water supply (P-value = .000), inadequate pumping infrastructures (P-value = .000), increasing population (P-value = .000), inaccessibility of the area due to lack of road infrastructures (P-value = .000) and inadequate water distribution tanker (p-value = .000) were significant at significant level of 0.05. which indicate that the null hypothesis was rejected and accepting the alternative hypothesis which state that there is a statistically significant to the 5-key causes of water scarcity in Minna metropolis. However, when Monte Carlo significant was run, the result also showed significant.

5 CONCLUSION AND RECOMMENDATION

This study on assessment of the causes of water scarcity in Minna metropolitan area of Niger, state focus on identifying the causes of water scarcity in Minna metropolis. Factor analysis was use to reduce the eleven causes of water scarcity into 5-major causes while Chi-square statistics were use to test the significance of these element causing water scarcity. The outcome of the study reveals that the causes of water scarcity in Minna metropolis among others consist of inadequate resources to provide adequate water supply, lack of facilities to accommodate the demand of water, corruption among water board staff and water shortage at source. In addition, the study showed that there is a statistically significant to inadequate resources to provide adequate water supply, inadequate pumping infrastructures, increasing population, inaccessibility of the area due to lack of road infrastructures and inadequate water distribution tanker which are the major causes of water scarcity in Minna. The study concluded that there is need for sustainable water supplies in Minna metropolis in order to curb the problems of water scarcity in Minna. The study therefore recommended that;

1. The government of Niger state should do everything necessary to provide appropriate funding for water abstraction infrastructure and other aspects that assist water distribution in Minna.
2. The government through the relevant agency should ensure that communities that are not linked to water distribution pipes have access roads so that water can be delivered via water tanker at least twice a week.

3. The government should encourage private individuals to invest in the water industry. These independent water vendors can also provide water tanker service to locations that are not served by the water board.
4. The activities of the Niger State Water and Sewerage Corporation should be checked in order to reduce employee corruption.

REFERENCES

- Abdullahi B. M., & Abdulrahman A. S. (2015). Water supply and distribution problems in developing countries: A case study of Jimeta-Yola, Nigeria. *International Journal of Scientific Engineering and Applied Science (IJSEAS)*, 1(4), 473-483. ISSN: 2395-3470
- Barney, J.B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*. 17 (1), 99–120. doi:10.1177/014920639101700108
- Bature, A. S, Lawal A. O & Noma M. (2021). Evaluation of water supply and sanitation situation in Kaduna Metropolis in Northern Nigeria. *Journal of Public Health Research*, 11(1), 1-14. DOI: 10.5923/j.phr.20211101.01
- Cheong, L. C. (1991). Unaccounted for water and the economics of leak detection, 18th *International Water Supply Congress & Exhibition*, Copenhagen, 15–31 May 1991.
- Dangana, K. & Muhammad, L.H. (2016). An assessment of household water accessibility in the southern part of Niger state, Nigeria. *Ethiopian Journal of Environmental Studies & Management*, 9(5), 567-578. ISSN: 1998-0507, doi: <http://dx.doi.org/10.4314/ejesm.v9i5.4>
- Desalegn, B. A. (2014). Assessing causes and challenges of Urban water supply: The case of Mekelle city. *International Journal of Science and Research (IJSR)*, 3(7), 1922-1928.
- Hassan, S., & Abbas, A. A. (2015). Effective factors in causing leakage in water supply systems and urban water distribution networks. *American Journal of Civil Engineering Research and Practices of Civil Engineering in Developing Countries*, 3 (2&2), 60-63. Doi: 10.11648/j.ajce.s.2015030202.22
- Howell N (2020). Water scarcity: Causes, effects and solutions. Retrieved from <https://earthandhuman.org/water-scarcity-causes-effects-and-solutions/>
- Ibrahim S. I., Alaci, D. S. A & Ajibade, L. T. (2014). Assessing Domestic Water Demand and Supply adequacy in Medium-sized Towns of Niger State Nigeria: Challenge for sustainable development. *Journal of Water Resource and Hydraulic Engineering*, 3 (4), 81-89.
- IPCC (2022). Climate change: Impacts, adaptation and vulnerability. IPCC sixth assessment, retrieved on <https://www.ipcc.ch/report/ar6/wg2/> (on March, 26th 2023)
- Kieran McConville (2022). 10 Causes of the global water crisis. Retrieved from <https://www.concernusa.org/story/global-water-crisis-causes/>
- Lai C. (2022). Water scarcity in Africa: Causes, effects, and solutions. Retrieved from <https://earth.org/water-scarcity-in-africa/>

- Ishiaku, I., Mohammed, A. E., Garba, I. K., Badaru, Y.U., & Aishatu, B. H. (2014). An assessment of alternative water source for domestic used in Minna metropolis, Niger State, Nigeria. *Journal of Environment and Earth Science*, 4(18),19-23.
- Mkonda, M.Y. (2015). Assessment of water shortage and its implications to gender role in semi-arid areas in Mvumi Ward, Dodoma in Tanzania. *Arts and Social Sciences Journal*, 6 (5), 142-146.
- Monney, I., Buamah, R., Odai, S., Awuah, E., & Nyenje, P.M (2013). Evaluating Access to Potable Water and Basic Sanitation in Ghana's Largest Urban Slum Community: Old Fadama, Accra. *Journal of Environment and Earth Science*, 3 (11), 72-79.
- Motsi E. M. & Daramy V. V. (2020). System Analysis of Portable Water Shortage in the Mpumalanga Province of South Africa. *Proceedings of the 2nd African International Conference on Industrial Engineering and Operations Management*. Harare Zimbabwe, 192-198.
- NPC (2006). National Population Census: National and State Population and Housing Tables, Vol.1. www.population.gov.ng/index.php/census
- Obisesan, A. & Famous, O. (2016) Factors affecting water supply in Owah-Abbi, Delta State. *Open Journal of Social Sciences*, 4(7), 137-146. <http://dx.doi.org/10.4236/jss.2016.47023>
- Olivia, L. (2022). Water shortage: Causes and effects. Retrieved from <https://earth.org/causes-and-effects-of-water-shortage/> (on 23rd March, 2023)
- Rahman, R.A., Romali, N.S., Sufian, S.S., & Seman, M. A. (2021). Affecting factors in rehabilitating water distribution networks. In: M.C.F. Cunha, V., Rezazadeh, M., Gowda, C. (eds) *Proceedings of the 3rd RILEM Spring Convention and Conference*. RILEM Book series, vol 35. Springer, Cham. https://doi.org/10.1007/978-3-030-76543-9_17
- Rijsberman, F. R. (2006). *Water scarcity: Fact or fiction?*. *Agricultural Water Management*. **80** (1–3): 5–22. [doi:10.1016/j.agwat.2005.07.001](https://doi.org/10.1016/j.agwat.2005.07.001)
- Shamir, U. & Howard, C.D.D. (1981). Water supply reliability theory. *Research and Technology Journal America Water Work Association*, 73(7), 379-384
- Shields, P., & Rangarjan, N. (2013) *A playbook for research methods: Integrating conceptual frameworks and project management*. New forums press, Stillwater.
- Tobore, O. (2022). Nigeria's hopeless fight against corruption. Retrieved from <https://www.dw.com/en/nigerias-hopeless-fight-against-corruption/a-61946896>
- United Nation (2021). Water scarcity. Retrieved from <https://www.unwater.org/water-facts/water-scarcity#:~:text=Water%20scarcity%20is%20a%20relative%20concept.%20The%20amount,supply%20is%20affected%20by%20decreasing%20quantity%20or%20quality>
- World Bank (2021). Improving water supply, sanitation and hygiene services in Nigeria. Retrieved from <https://www.worldbank.org/en/news/press-release/2021/05/25/improving-water-supply-sanitation-and-hygiene-services-in-nigeria>